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Separating Means and Ends: Reorienting Energy Efficiency Programs and Policy Toward Reducing Energy Consumption in California

Energy Division of the California Public Utilities Commission

Prepared by
Reuben Deumling, Consultant
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Executive Summary

California's Global Warming Solutions Act of 2006 (AB32) now mandates that the long-standing pattern of ever-increasing energy consumption from fossil fuels be summarily reversed. How this is to be accomplished is still largely an open question. Absolute reductions in statewide energy consumption cannot be brought about by relying on energy efficiency as practiced, unless and until the specific tradeoffs between the pursuit of (relative) savings and the need for (absolute) reductions in energy consumption are identified and problematized. Although resolving this tension will not be easy, this paper suggests several conceptual, methodological, and practical strategies with which to pursue this objective. Energy efficiency is not the end but potentially one of the means toward the end of lower total energy consumption.

To advance toward this goal we need to pursue several parallel courses of action: Conceptually we need to articulate a theory of how and why energy consumption growth occurs, as well as a theory of how this growth is to be reversed. Such a theory cannot supply policy-relevant advice without serious attention to the human dimensions of energy consumption. Policies designed to achieve the goals of AB32 might start by recognizing the large spread in levels of energy consumption between otherwise similar households. Such policies could exploit this inter-household variability as a pedagogic device: examining and publicizing existing low-use behaviors or circumstances corresponding to such low use, and offer guidance on how to replicate these conditions. In this approach, expert knowledge would be utilized not to prescribe standard bundles of technical solutions to everyone, but to identify which technologies, habits, and building characteristics yield results corresponding to desired low energy consumption patterns. This would be a pragmatic bottom-up approach to the problem, conceptually the inverse of the energy efficiency program framing currently favored.

Methodologically we need to revisit the accounting methods employed within the field of energy efficiency. "Savings" as tallied do not translate straightforwardly into reduced energy consumption. Furthermore, the boundaries drawn around energy efficiency systematically exclude energy-relevant actions by members of households because they are assumed to lack the "persistence" of hardware installations. The goals of AB32 would be better served by replacing this confusion of means and end with a pluralist approach organized around the human dimensions of energy consumption.

Paying greater attention to supplying usable energy information to end users, utilizing social marketing techniques, revising energy rate designs, organizing low usage contests, and exploiting existing variation in use patterns are some possible practical steps toward achieving the goals of AB32. By paying attention to people as energy consumers, adjusting energy prices and rate schedules, pursuing multiple creative parallel strategies, and setting ambitious goals, it is possible to reduce energy consumption in step with the mandated targets. Energy experts can and must lead this effort, but in doing so they could learn much from those whose experiences have yielded the energy consumption patterns AB32 now requires.

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Introduction: the challenges of AB32

Policymakers in the state of California have precipitated a watershed moment. California's Global Warming Solutions Act of 2006 (AB32) now mandates that the long-standing pattern of ever-increasing energy consumption from fossil fuels be summarily reversed, beginning a process through which the absolute amount of energy consumed in the state must decline by more than eighty percent over the next 40+ years.[1] How this is to be accomplished is to a certain extent an open question. Energy efficiency and a phased transition to renewables are obvious and much touted elements of the anticipated response. The fact that the historic growth *rate* of fossil fuel consumption in California has slowed to approximately one percent per year since 1990 is promising, even as the annual increment is still quite large. The expectation of continued rapid population growth within the state further complicates the matter.

The changes which the passage of AB32 requires must be identified and enumerated as clearly as possible (Figure 1). It will be necessary to translate absolute consumption limits, and

[1] While Executive Order S-3-05 http://www.dot.ca.gov/hq/energy/ExecOrderS-3-05.htm adds the 2050 target date to the two dates (2010 and 2020) stipulated in AB32; for the sake of readability in this paper I will refer simply to AB32 when discussing legislative and policy-making time tables. The text of AB32 is found here: http://www.arb.ca.gov/cc/docs/ab32text.pdf .

greenhouse gas (GHG) emission levels to which policymakers and state leaders are now committed to returning, into concrete strategies and timelines. Population growth and its influence on the rates of negative energy growth corresponding to these goals will also necessarily become part of the discussion. Once concrete rates and quantities (further divided by sector) are established, it will be necessary to identify what contribution energy efficiency can be expected to make.

Past GHG emissions from the burning of fossil fuels in California can be apportioned to different sectors and fuels. The primary culprits are transportation, natural gas end uses, and the generation and consumption of electricity. In this paper I focus on electricity consumption in California, as this is the component of the state's energy balance to which energy efficiency has been applied most intensively to date.[2]

The question this white paper explores is whether, and if so how, it may be possible to re-orient or reframe the pursuit of energy efficiency in ways that contribute to the absolute reductions in California's energy consumption now recognized to be necessary.

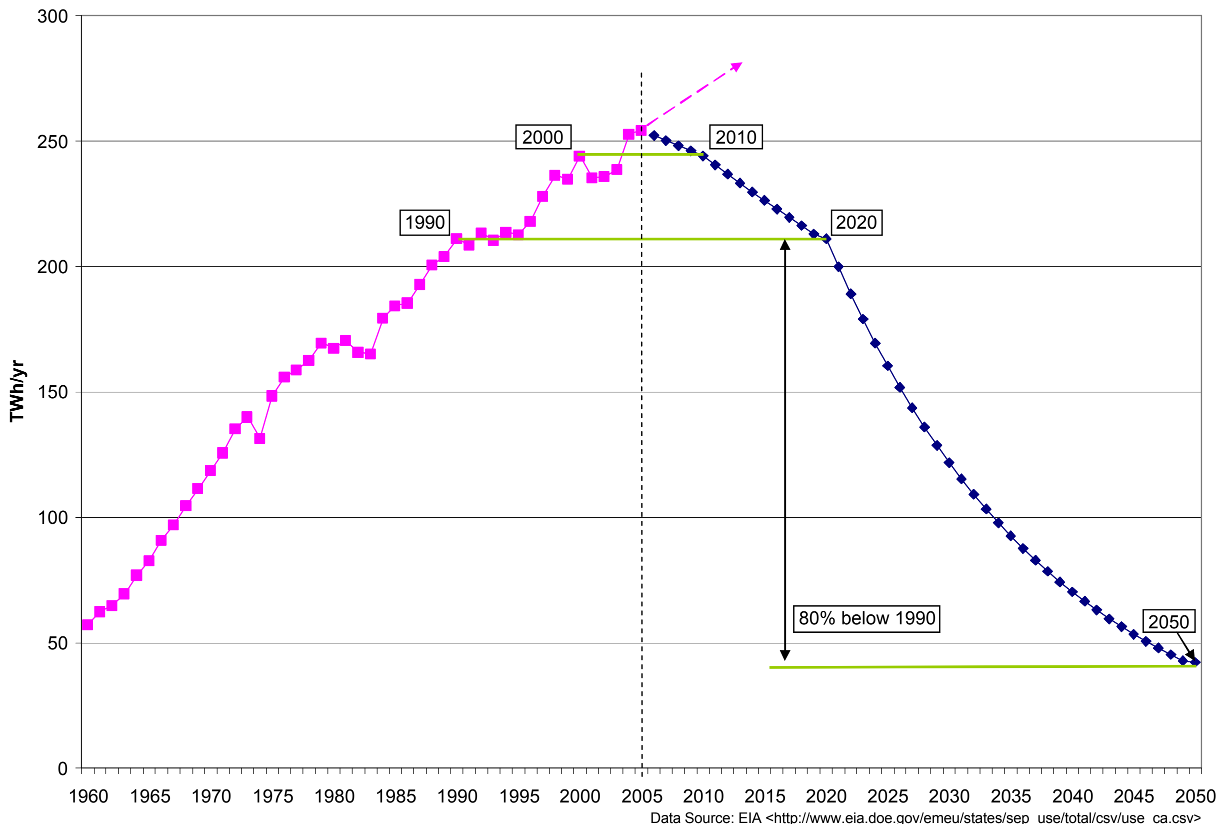

Figure 1. Total California electricity consumption 1960-2005 and a trajectory through 2050 based on timetables set out in Assembly Bill 32 and Executive Order S-3-05

[2] Natural gas consumption in the state's residential sector has remained flat over the past two decades, a fact little noted in the energy efficiency literature. While population (= natural gas account) growth rose 41% btw 1985 and 2005, this was offset by reductions in consumption at the household level of 37% over the same period, data supplied by CEC.

Global warming, energy efficiency, and California energy policy

Re-framing energy policy around a prospective target

Recent policy documents addressing California's and the United States' energy futures (State of California, 2005 (EAP II), US EPA, 2006 (NEP)) continue to suggest it is possible to meet expected growing demand for energy by building more power plants *and* rely on energy efficiency to defer the need to do so. While this two-track approach to energy policy may have appeared persuasive before the recognition that GHG emissions had to be rapidly and significantly reduced, neither of these strategies is commensurate with the problem at hand. These two documents both reveal a basic failure to understand the energy choices global warming and AB32 demand of California policymakers.

For one, the framing of these policy documents misses the core challenge of AB32: preparing to build new power plants and working toward reducing the *rate of growth* in energy consumption are both obsolete strategies with little bearing on the goal of throttling statewide greenhouse gas emissions in the immediate future. What's more, both energy efficiency's scope and its ability to usher in sustained negative growth rates in energy consumption remain unclear. Although energy efficiency presently appears to be the best funded, most developed, and consequently most obvious component of California's energy policy infrastructure relevant to charting a course toward these ends, its suitability to helping meet these goals has not been carefully examined. Claims on behalf of energy efficiency's suitability to the task circulate, but empirical support for them is rarely provided. At times some of energy efficiency's advocates even acknowledge that energy efficiency, as practiced, can at best "help offset 20-50% of expected growth in energy demand in some areas" (Nadel et al. 2004).

Without examining these matters, achieving GHG emissions reductions in California seems elusive. Although energy efficiency, like curbside recycling, and automobile fuel economy has made great strides over the past several decades, in the US the consumption of electricity, generation of municipal solid waste, and consumption of gasoline all continue to rise inexorably, notwithstanding these policy successes. The main reason is that these various policies were pursued and assessed *without reference to an absolute, prospective target.* The means chosen in each case turned out to be only loosely coupled to the parameters they were meant to help reduce (consumption of electricity and gasoline, generation of solid waste). One consequence of this is that the public policy strategies (means) are increasingly mistaken for the goal (end). In other words, more energy efficiency or more recycling is asserted to be inherently beneficial, without pausing to ascertain whether or in what sense such intensification may correspond to the original objective (Moezzi & Diamond, 2004).

Once policy language is adopted which places absolute limits on any one of these categories, however, it becomes necessary for policymakers to identify and develop new tools and metrics with which to advance toward these goals. AB32 supplies such language and a series of hard targets in the realm of energy, altogether different from the framework within which energy efficiency has been deployed over the past few decades.

Energy efficiency in a warming world

It is necessary to clarify what the goals of energy efficiency are—all the more so in the face of AB32. Is it to reduce the growth rate in energy consumption (Nadel et al., 2004)? To "halve energy use in industrial nations" (Chandler, 1985)? To offset or defer the need for building new power plants (Rosenfeld, 1999)? Is energy efficiency expected to achieve 50% of the reductions in energy consumption required by AB32 (Chang et al., 2007)? And how has the pursuit of energy efficiency to date intersected with such factors as population growth? AB32, with its absolute, prospective targets, has changed the terms of the debate. With a mandate to reduce total energy consumption by more than 80%,[3] it is arguably no longer possible to ignore the role of population growth in the context of California's energy future.

In contrast to much of the rest of the US, California's *per capita* energy consumption is quite low (49th in residential energy consumption) and has grown relatively slowly over the past thirty years. This trajectory can be traced to a variety of factors including a mild climate, high population density, a history of relatively high retail energy prices, early adoption of and sustained attention to appliance and building energy codes and standards, and more recently some of the largest commitments of funds to energy efficiency programs anywhere in the world. The present low per capita energy consumption level and low post-1973 growth rate represent policy achievements and are justly celebrated.[4] Because total energy consumption and the population of the state have continued to increase steadily, however, it is unclear whether, or to what extent, the *per capita* energy "savings," on which so much attention has focused in the policy realm can be used to guide future policy directed toward reducing *total* energy consumption in California.

Although the absolute increases are still large, the rate at which California's statewide electricity consumption is increasing has slowed markedly over the past several decades. California's recent (1990-2005) statewide growth in electricity consumption has averaged 1.3% per year. To comply with the requirements of AB32, statewide electricity consumption must be reduced (starting in 2006) by 0.8%/yr through 2010, 1.5%/yr the following decade, and 5.4%/yr between 2020 and 2050. Consequently, the short term rate of change *from the current trend* is the sum of the two absolute values, (1.3% + 0.8%) or -2.1% per year to meet the 2010 goal. In absolute terms, AB32 mandates negative growth in energy consumption for the state as a whole at rates comparable to positive growth rates observed during the 1970s (see Table 1).

	10-yr electricity consumption growth rates (total)	10-yr electricity consumption growth rates (residential)
1960s	+107%	+139%
1970s	+41%	+45%
1980s	+26%	+28%
1990s	+16%	+19%
2000-'05	+4%	+9%

[3] The 2050 target of Executive Order S-3-05 applied to the electricity sector translates into an 83% reduction relative to the 2005 consumption level.

[4] Reconstructing the role of state policies in bringing about this impressive per capita showing is difficult. Chang et al. suggest in their Fig 7 that by 2003 some 40 TWh/yr (17% of 2003 electricity consumption in CA) were *not* consumed because of such policies. This is roughly equal to 25% of the CA-US difference in per capita electricity consumption today (0.17*7,300kWh/yr)/(12,000kWh-7,300kWh). Yet other states and countries can point to similarly flat per capita growth rates since 1973 (e.g., New Zealand and Oregon), with different policy histories.

2005-'10	***-4%***	
2010-'20	***-14%***	
2020-'30	***-42%***	
2030-'40	***-42%***	
2040-'50	***-40%***	

Table 1: Past and AB32-mandated 10-year growth rates of electricity consumption

Two plausible complications arise in conjunction with these proposed negative growth rates. The first concerns possible energy consumption growth since 2005 that cannot yet be quantified. The second concerns population growth after 2005. In this latter case, the negative rates of electricity growth delineated in Table 1 will have to be increased *per capita* as long as the expectation of continued population growth continues to be fulfilled.

While energy efficiency is not the only AB32-applicable strategy available to policymakers in California, it is the one on which rest the greatest expectations. Chang et al., for instance, anticipate that as much as 50% of the reductions required by AB32 in the near term will be achieved through energy efficiency. Certainly codes and standards, the energy efficiency policies and programs currently in place, as well as the cumulative knowledge and experience related to matters of energy policy and energy consumption within the state, all represent investments in infrastructure, knowledge, and people that can help identify, develop, and carry out the efforts that will be necessary to comply with AB32. The challenge is to reinterpret or refocus these investments in light of the new, long-term objective.

Energy efficiency has not hitherto been expected to demonstrate that it is necessary or even sufficient to achieve the long term goals of a policy such as AB32. It has been very helpful in generating technical results that can be adopted into products which consequently use less energy: brighter and more energy efficient LEDs, cheaper CFLs with better color rendition and smaller ballasts, better batteries, variable speed motors, improved refrigerator insulation, etc. These enable (but do not guarantee) continuation of the present level of material comforts with much less energy waste. It is difficult to predict whether the application of energy efficiency (as practiced) will (or can) cause total electricity consumption to decrease. While there are familiar reasons that suggest the successful deployment of energy efficiency will reduce consumption of electricity, there are equally plausible reasons why this will not necessarily occur. The quintessential examples of the CFL or the energy efficient new refrigerator suggest a straightforward substitution with consequent reductions in the amount of energy demanded. However, in practice this device-level saving fails to scale up for various reasons: consumption growth, population growth, and energy efficiency's complementary[5] role vis-à-vis economic growth, to name a few.

> While each year reports from the efficiency community claim or promise substantial reductions in carbon emissions, the constructed baseline is often one of substantial projected growth based on current end uses. In the meantime, society's ability to think of new ways to use energy grows even as technical efficiency increases. The

[5] The ENERGY STAR Philosophy list begins: "Expand markets for energy-efficient products…." See www.**energystar**.gov/ .

> more energy services demanded, the more potential to save. Energy efficiency itself often becomes a good to be "consumed" (Moezzi and Diamond, 2004).

It is important to avoid the common mistake of treating energy efficiency as a philosophy or template for *how* this shift toward lower consumption is to take place.

The effort that has gone into aligning the technical principles underlying energy efficiency (Watts/cubic foot; Watts/lumens, etc.) with the marketing context into which it is inserted (differential profitability, product hierarchies[6], features) has not yielded absolute reductions in energy consumption. Two important reasons are (1) that energy efficiency's success to date has been achieved in no small part by encouraging constituents to upgrade hardware and end-use technologies, and (2) that the focus on more energy efficient replacements has distracted attention from the meter, from paying attention to total consumption (Moezzi & Diamond, 2004). Producers of these more efficient technologies seek to persuade consumers, whether as individuals, businesses, or institutions, to 'trade up,' and many consumers are only too willing to participate, especially when doing so is represented as good for the environment. Because the private sector exerts far more influence over which particular kinds of products will be developed and available for purchase than do consumers or the government, however, energy efficiency as a product characteristic is pursued in ways that conform to existing product hierarchies—often trumping the goal of reducing absolute energy consumption.

The ENERGY STAR appliance program, for example, has been successful in proportion to its ability to sell models which offer the highest profit margins. The majority of ENERGY STAR refrigerator models available since the program's inception in 1997 have been in the side-by-side category, and feature through-the-door ice and water. Yet purchasing either of these (style or feature) was explicitly discouraged by governments, energy authorities, and opinion-makers before the advent of energy efficiency. The case of the California ENERGY STAR New Homes program has fared similarly, where the (successful) pursuit of energy efficiency was recently acknowledged to have failed to reduce energy consumption in some climate zones (RLW Analytics, 2006:11).

Absolute reductions in statewide energy consumption cannot be brought about by relying on energy efficiency as practiced, much less so the 80+% reductions now mandated, unless and until the specific tradeoffs between profitability and unit energy consumption (UEC), between price and energy efficiency, and between (relative) savings and (absolute) energy consumption are identified and problematized. These reductions cannot be achieved by relying on the institutions that presently design and market energy efficient products toward sales growth. Within this realm the most profitable, high-end products necessarily win the popularity contest for the prominent spots on the showroom floor, e.g., side-by-side refrigerators, hybrid SUVs, plasma TVs, etc. Other products, which may or may not be energy efficient but are frugal in their use of energy, are rendered invisible.

Energy efficiency is a means toward many possible ends. Currently it is predominately deployed toward the end of selling replacement products: end-use devices that are more energy efficient than what is assumed to be in-use, or than the average new product. In many instances, however, these products may be larger or more featured, and may ultimately

[6] By product hierarchies I mean the widely understood ranking of, for instance, refrigerator styles, where large built-in and side-by-side styles reside at the top, and small manual defrost configurations languish at the bottom.

encourage or enable higher saturations than what is found today. Examining three different technologies (air conditioners, refrigerators, and new housing) Moezzi and Diamond find evidence of this slippage: "Energy efficiency programs can normalize and thus sponsor, technically and socially, additional, albeit technically efficient consumption (2004:45)." This upgrading is represented within the policy realm as good for the economy and good for energy efficiency's public relations, but this approach can be counterproductive if the goal reverts back to net reductions in energy consumption. Energy efficiency must be redeployed toward net reductions in consumption, but to do so requires establishing a framework within which it serves the goals of AB32.

Human dimensions: potential and limitations for policy

The problem of how to reconfigure energy efficiency policies such that they cause energy consumption to fall is to a considerable extent conceptual: policy experts and energy professionals have over the past twenty years accumulated experience with energy efficiency, to the exclusion of other frames with which to understand and approach the problem—with the problem definition shifting from 'too much energy consumption' to 'not enough energy efficiency.' The language, concepts, assumptions, and institutional infrastructures that constitute energy efficiency today delimit how the problem of increasing (or too much) energy consumption is understood.

Energy efficiency, then, has come to be defined narrowly as a set of technical interventions, in opposition to energy conservation, a more expansive approach which often includes attention to the social context of energy consumption. For various reasons, energy conservation is now more commonly understood to be an emergency response involving inconvenient but sometimes necessary adjustments by individual energy users, whereas energy efficiency encompasses calculable and persistent hardware interventions that do not require participatory effort by end users. The exclusion of Manual Defrost refrigerators from the ENERGY STAR designation in the program's first five years exemplifies how wary policymakers can be of user input. Despite the lower unit energy consumption (UEC) values for Manual Defrost refrigerators, and a long-standing identification of Manual Defrost with lower operating cost/lower energy consumption, such refrigerators were ineligible for an ENERGY STAR label. One reason for this decision was the belief within US DOE that ENERGY STAR must steer clear of products that depend on users to do certain things to guarantee performance—in this case, to defrost the refrigerator (Noel, 2002).

What are sometimes called the *human dimensions* of energy consumption are attributes that are more easily captured by the framing of the energy problem that existed prior to the ascendance of energy efficiency. The myriad roles that people as energy users occupy—for instance, as investors, as consumers, as members of a social group, as an expression of personal values, and as a problem avoider, all suggest different ways people make sense of energy use (Stern & Aronson, 1984). In as much as these roles help us understand how energy consumption is shaped, careful examination of these can also supply insights into the possibility of ratcheting down the resultant consumption levels.

Energy policy professionals and energy efficiency advocates today generally treat continued energy consumption growth as exogenous and inquire into the matter no further. Although reducing energy consumption was an explicit goal of energy policy in the 1970s and into the early 1980s, the goals of energy policy have shifted away from absolute reductions since world oil prices dropped in 1985. Within the present energy efficiency framing of the problem no theory is articulated for how either growth in energy consumption is to be reversed, or what energy efficiency's specific role and contributions might be toward this end. We need such a theory. Such a theory would necessarily also take account of people as energy users and people as potential co-producers of the reductions in energy consumption now mandated (Neiman, 1989). Instead of conceptualizing people as passive and predominately reluctant consumers drawn to inefficient new products, who require financial incentives to purchase energy efficient comparable products instead, this theory would recognize the myriad ways in which people as energy users must act and make decisions subject to the constraints of infrastructures and the built environment; how we negotiate social and cultural expectations related to energy consumption; and how we make sense of the products, choices, and policies we encounter.

The present moment demands a more fundamental shift in energy policy and planning than current energy policy documents suggest is envisioned (EAP II; NEP; Cal EPA, 2006). Part of the difficulty with conceptualizing this shift may lie in the fact that few large scale absolute reductions in energy consumption have yet occurred in response to policy measures in the US. Therefore, even as energy efficiency programs and policies are assumed to be the state's best defense against global warming, energy efficiency advocates have ceased to promise absolute reductions in energy consumption from interventions they recommend (Rosenfeld, 2006). When significant absolute reductions in electricity consumption have occurred (e.g., thirteen percent nationwide for residential uses between 1978 and '81; six percent statewide in California in 2001) these changes were driven in no small part by supply crises and a widely felt sense of urgency on the part of the public. Policies certainly played a role, but they did not drive the reductions, and the specific recommendations and strategies suggested by public entities at these times did not necessarily match the kind and scope of the observed declines (Lutzenhiser et al., 2004).

Subsequent returns to higher levels of energy consumption following such declines are often interpreted by policymakers and energy efficiency advocates as indicating that the savings so achieved are unreliable. They are characterized as having "lower persistence" than hardware installations (Xenergy, 2002: 6-25). Although energy consumption has been observed to rebound after such declines, the automatic privileging of hardware over everything else derives from expert assumptions about the trustworthiness of machines vs. people, the analytic separation between the two, and about the drivers of energy consumption. Whether or to what extent these assumptions have been tested is unclear. That behavioral changes can yield significant energy savings is beyond dispute. This is an important reason such changes are advocated at times of crisis. The matter of persistence, then, is a function both of individual habit and of ongoing collective judgments about the efficacy and necessity of such actions. If the overriding message experts broadcast to the public is that behavioral adjustments are only stopgap/emergency responses and unsuited for the long run (as it was in 2001), this will not be lost on the intended audience. Such circular reasoning itself thwarts the present effort. The task before us must involve learning to avoid prejudging the efficacy of this or that strategy and tainting the experiment in so doing.

Recommendations

Revise accounting practices: savings calculations

Energy efficiency program evaluations are designed to ascertain the cost effectiveness of various interventions. This narrow analytic focus does not scale up well to the level at which policymakers are seeking to identify strategies for complying with AB32. In California and elsewhere the prevailing method for evaluating energy efficiency programs and policies, as well as the impact of codes and standards, is to tabulate energy savings attributable to specific interventions, such as lighting replacements, refrigerator recycling, or appliance and building standards. The energy "savings" calculated in this manner are commonly derived from engineering estimates of the electricity *not* consumed as a consequence of these interventions. Tracking progress toward the goals set out in AB32, however, requires a different approach; one that inverts the accounting framework such that actual energy consumption is measured rather than the necessarily hypothetical savings.

An important reason to reframe the accounting is that the savings so generated are only very loosely coupled to absolute reductions in consumption (Moezzi & Diamond, 2004). The total savings attributed to energy efficiency in CA between 2000 and 2005, for instance—some 180TWh—have coincided with net increases in statewide electricity consumption of some 10TWh over this period.[7] This mismatch between policy goals and accounting is no longer tenable. Measuring energy consumption is fairly straightforward—utility customer meters are already read regularly. What is less straightforward, and a significant reason this approach to tracking total energy consumption has fallen out of favor in the context of energy efficiency program evaluation, is that factors over which program implementers have very little or no control may also affect the total energy consumed by the household, business, or other entity (Peach, 2005). Demographic changes within households, changes in employment and income levels, increased saturation of certain categories of end use technologies such as consumer electronics, etc. all affect how much energy is consumed, and how this quantity changes over time. Though program evaluation concerned with cost effectiveness has a place, its results should not be assumed to offer guidance in pursuit of AB32.

The challenge of complying with AB32 is that the prospective nature of the reduction goal now supersedes this program-level accounting framework by mandating statewide reductions. Consequently all the "noise" hitherto ignored in program evaluations must now be taken into consideration in the pursuit of statewide reductions. And not all of the "noise" represents consumption—some of it is conservation. The existing method of imputing savings in relation to a baseline also excludes those changes in energy consumption not directly attributable to hardware installations. While this supports the filtering of program-independent decisions and actions that might correspond to changes in energy consumption from program-induced savings, it also has the unfortunate (sociological) effect on both expert and participant of devaluing (by not counting) all efforts not linked or directly attributable to energy efficiency programs. This distinction is not conducive to the kind of results now required.

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[7] Savings figures are from Rosenfeld, 2006 (slides 7, 22); consumption growth figures are from EIA: <http://www.eia.doe.gov/emeu/states/sep_use/total/csv/use_ca.cs>

Energy "savings" found in Nadel et al.'s meta-analysis of recent energy efficiency studies, for instance, are limited to hardware: only one-third of California's 6% observed drop in energy consumption in 2001 is counted as program-induced, because the remainder was not attributable to hardware (2004:9). The design of California's "20/20 program," by contrast, did not stipulate how the reductions were to be generated. During the summer months of 2001 and again in 2002, California electricity customers who achieved a minimum 20% monthly savings over their consumption the previous year qualified for an additional 20% reduction in their bill. Though the program was considered expensive by some, and energy policy experts criticized its propensity to reward those whose savings were due to factors they considered illegitimate, or that were due to "natural variation," the discovery that the average monthly savings for residential electricity customers participating in the 2001 program was 37% suggests there is substantially more potential for reductions than assumed.[8]

Reprioritize attention to people as participants: revisiting the human dimensions

Energy efficiency experts work within a circumscribed technology-focused context where engagement with people, behavior, habit, and individual variation is minimized. These programs and those who implement them consequently are usually denied opportunities to learn how and why energy is consumed in the way it is. Reducing the *rate* at which energy consumption grows by 20-50% is not a helpful way to frame a path to meet AB32 goals, unless one clearly identifies other strategies which can be relied upon to make up the difference. What would be required to reduce consumption by, for instance, 5% per year? Where are such reductions currently being pursued? What can be learned from these efforts? What role do hardware upgrades play in such scenarios? (see also Shove et al, 1998).

Instead of excluding two-thirds of the savings observed in 2001 in California as exogenous and unrelated to energy efficiency (Nadel et al., 2004), efforts to comply with AB32 must examine all factors contributing to observed reductions in energy consumption. Energy efficiency is not the end, but the means, or rather potentially one of the means, toward the end of lower total energy consumption. A pragmatic pluralist approach is needed, which recognizes that the present circumstances demand consideration of all potential strategies. Energy efficiency has been well-funded, widely implemented, and is generally considered a very successful policy approach to problems related to energy consumption. Existing analyses of the fit between policy and objective, however, have focused on the question of savings, as outlined above, rather than on the absolute amount of energy consumed. When energy efficiency's success is assumed to recommend it as a strategy for complying with AB32, it is necessary to qualify exactly how past experiences with energy efficiency pertain to the present objectives.

One question that must be asked is how well the present approach to energy savings, suggesting as it does modest reductions in consumption on the order of several percent, motivates action toward these ends (Moezzi & Diamond, 2004:19). Since much larger reductions are now required, and recognized (by some experts) to be achievable (see California's 20/20 program), might it be worth exploring whether the prospect of much larger savings could be more motivating? Realizing that the average reduction in monthly electricity

[8] More than 30% of California residential electricity customers qualified for a rebate through this program (personal communication, Andrew Bell, PG&E, April, 2002).

consumption by 20/20 program participants in the summer of 2001 was 37%, staff in the Energy Office of the City of Berkeley, for instance, contemplated the possibility of introducing a 50/50 program. Others such as the *Carbon Rationing Action Groups* in the U.K. are pursuing reductions of 10% per year.[9] Some are going much further, calling for 90% reductions in one year.[10]

The Hood River Conservation Project (HRCP) of 1982/83 is considered to have been an exceptionally successful implementation, yielding some 13% reductions in energy consumption for the community as a whole (Hirst, 1988). Though this program did not explicitly focus on the human dimensions of energy consumption, its unusual level of participation (91% of all households) suggests attention to "marketing" can pay off:

> The key factors leading to high participation include the offer of free measures, determination on the part of HRCP staff to enlist every eligible household, the use of many community-based marketing approaches, extensive word-of-mouth communication among Hood River residents (…), and the early-1985 personal contacts by staff among the remaining nonparticipants. (ibid.: 317)

The unusual amount of data collected in this program also revealed much about what influenced pre- and post-intervention energy consumption, and helped explain the familiar finding that the actual household-level savings, though impressive, were less than anticipated.

Another challenge presented by the long-standing neglect of the human dimensions of energy consumption is what we might term the loss of cultural affinity for energy conservation. To the extent that the public we hope to address and inspire has forgotten how to use less energy—what rules of thumb, habits, and judgments correspond to a less energy intensive way of life—we must devise a way to restore this loss of collective memory. Widely disparate energy consumption rates in the present suggest that this loss may be unevenly distributed. If that is so, experts would do well to approach this situation with the expectation that much can be learned from members of the public. Finally, the requisite infrastructure which facilitated a lower-energy society may also have atrophied and will need to be rebuilt.

Exploring complementary strategies

Ever more and larger appliances, the proliferation of consumer electronics, larger houses with fewer occupants, the rapid increase in standby power consumption, and feature creep, whereby, for instance, central air conditioning is increasingly viewed as necessary regardless of climate zone or local building tradition—these trends are not easily reversed but there are certain places policymakers might look for guidance on how to begin to move in this direction. Energy efficiency in its present guise accommodates all of these trends in as much as it is deployed as a strategy that renders discussion of absolute limits obsolete or inadmissible (Moezzi & Diamond, 2004). Its energies are directed toward generating and making available more efficient versions of the existing (and ever expanding) suite of technologies.

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[9] http://www.carbonrationing.org.uk/

[10] This is the objective of the recently initiated *Riot for Austerity,* who draw their inspiration from George Monbiot's recent book *Heat:* http://groups.yahoo.com/group/90PercentReduction/

In seeking to overcome these features of our present policy, several questions are worth considering:

- What policies or practices yielded absolute reductions in the past?
- What can be learned from present variation within a given sector?
- What contributions can energy efficiency be expected to make?
- What can the human dimensions of energy consumption teach about the pursuit of absolute reductions?

Beyond the realm of hardware replacements, a variety of approaches to understanding and reducing energy consumption have been explored. Many of these were pursued in the 1970s and early '80s when public concern over rising energy consumption was especially pronounced. All have since drifted to the margins of US policy attention with the decline in world oil prices and the rise of energy efficiency. This paper does not examine the reasons why this shift in emphasis occurred but rather seeks to identify efforts that might be worth dusting off to advance the goals of AB32.

Informational strategies

Informational strategies are designed primarily to overcome the invisibility of energy consumption. Someone who is not an energy expert, for instance, will find it hard to obtain answers to questions such as the following: How much energy is associated with specific tasks or end uses? How much of a reduction in kWh are certain changes in hardware or adjustments in use patterns likely to register? How does my household consumption compare to others in my neighborhood? Supplying information about these matters can help demystify energy and its consumption within households. Recent experience in California suggests that a sizable fraction of the public is in fact interested in conserving (reducing their consumption of) electricity, but these same people are often unsure how to go about it; or they focus on actions or replace technologies that may not actually save as much energy as other equally plausible strategies (Lutzenhiser et al, 2004; Kempton & Layne, 1994).

One approach to supplying more or better information involves changes to billing formats that graphically compare households' consumption levels. While such information cannot be assumed to reduce energy consumption by itself, it can motivate and/or facilitate change in that direction. Another approach that has been found successful in reducing consumption is supplying or installing end use meters in households which convey information about the consumption of individual devices such as a refrigerator, stove, or TV. What these efforts suggest is that patterns of energy consumption, once they are rendered visible, can be altered, even without additional encouragement. Enabling energy users to appreciate how their habits and routines translate into end use-specific kWh consumption provides feedback that has been observed to lower consumption by as much as 13% in a very short amount of time (Dobson & Griffin, 1992).

Social marketing

Social marketing refers to a set of interventions designed to motivate changes in behavior and delivered at the community level (McKenzie-Mohr, 1999). The basic premise is that information supplied by a person in a language that is familiar, specific, and evocative stands a greater chance of being acted on than if the message is broadcast in an impersonal or abstract format. In the mid 1980s researchers tried a social marketing approach to home energy audits in PG&E service territory. Telephone interviews and utility records indicated that participants acted on auditor recommendations at significantly higher rates than were observed for a control group, including applying for utility programs to finance retrofits (Gonzales, Aronson & Costanzo, 1988).

Rate design

Present electricity rate designs do not encourage energy conservation. Although block rates make consumption above a set point more expensive, the increments between blocks are large and the price premium for higher consumption is generally modest. Also, fixed monthly charges that are unaffected by reductions in consumption effectively penalize low users. One way to rectify this involves revising the rates such that the revenue generated by fixed charges is shifted onto the kWh charge. Eliminating fixed charges increases the cost of consuming a kWh slightly and rewards low users with proportionately low bills. A more radical approach common in some countries involves identifying a minimum level of electricity to be supplied to customers free of charge, with a revised rate structure applied to consumption above that level. This tariff suggests a minimum (necessary) amount of electricity, which for the present purposes would have to be set low enough to avoid discouraging conservation by those already below it. For instance, the base (free) quantity could be set at the 5^{th} percentile of electricity consumption for occupied housing, or even lower.

The annual reductions stipulated by AB32 suggest the plausibility of adopting such a rate structure into a dynamic model whereby the quantities supplied free, the block rate cutoffs, or other thresholds, are all ratcheted downward annually by the current percentage (see Figure 1). Such a structure would not only supply financial incentives to electric customers to reduce their consumption, it would also convey vividly the central message of AB32: that each customer is encouraged to and rewarded for participating in this long range adjustment to lower levels of energy consumption.

Contests/Competition

Another means of translating the need for public participation in complying with AB32 into actions involves local competition. Setting up a contest in which households are encouraged to vie for categories such as lowest monthly bill, most reduced bill over the previous year, or lowest usage per resident can garner not only interest, it could be an opportunity for both the public and energy experts to learn from each other about what works, and what low energy consumption lifestyles entail. Conducted regularly such contests can offer accountability and serve as an ongoing reminder of both the need for and the possibility of reducing energy consumption. A variation on this approach has taken hold in Great Britain, where Carbon Rationing Action Groups have formed. Members of such groups pledge to reduce their household carbon emissions by ten percent every year, while committing to pay penalties per ton of carbon they fail to reduce (Carbon Rationing Action Group).

AB32 requires an eventual (2050) reduction of some 83% relative to California's statewide 2005 electricity consumption. One way to discover what this will mean for policy could involve a special kind of contest along the following lines:

1. Select a dozen California households from different socioeconomic, demographic, and geographic categories in California;
2. Identify a team of energy experts well acquainted with household energy conservation, efficiency, and social marketing;
3. Experts and residents of these households are then set the joint task of achieving an 83% reduction in household electricity and natural gas consumption in, say, three years.

Ample funding would be important, less for purchasing hardware than for the analysis of the experiment. Renewables could be left out of this study, with a preliminary cap on hardware investments of, perhaps, $2,000 per household. (If households achieve the reductions with lower investment or sooner, they get more points.) Regular sessions between participants and the experts involved would allow for reviewing progress, timelines, budgets, and problems encountered. Such a contest could show that this poorly understood and therefore daunting long term goal can be achieved under these experimental conditions, and that the resulting arrangements within the households can yield coherent, comfortable, and perhaps even interesting lives.

While the parameters outlined above are merely a first draft of such an undertaking, in principle such an experiment should yield a wealth of insights. It would certainly take some of the mystery, fear, and denial out of the whole matter, and it would afford many opportunities for learning. It would also represent an effort commensurate with the problem, and bring into focus the limits of the current strategy.

Variations in use

Changes to the billing format can enable electricity customers to gauge their consumption levels in relation to others. These inter-household differences also have more direct implications for policy. Though such variation in energy consumption is observed to be large,[11] one would never know it from the way energy policies are structured. Policy prescriptions generally presume an average household with average use patterns. Online household energy calculators maintained by California's IOUs, for instance, usually base their recommendations on an average household's equipment and consumption. Besides being a simplification, this is unhelpful if the goal is to help people reduce *their* energy consumption. Given that the spread is (potentially) quite large between otherwise similar households, policies designed to achieve the goals of AB32 might instead start by recognizing this fact. Such policies could exploit inter-household variability as a pedagogic device; examining and publicizing existing low use behaviors or circumstances corresponding to such low use, and offer guidance on how to replicate these conditions. This would be a pragmatic bottom-up approach to the problem, conceptually almost the exact inverse of the energy efficiency program framing currently favored. In this approach, expert knowledge would be utilized not to prescribe standard bundles of technical solutions to everyone, but to identify and communicate what combinations of end use devices, habits, and building characteristics are observed to yield results corresponding to desired low energy consumption.

[11] Residential customers within the city of Berkeley, CA were found to differ by a factor of more than 100 for both gas and electricity. Some of this variation is due to differences in fuel source, but much is unexplained. See also Hackett & Lutzenhiser, 1991.

To generate a guide for how others could shift their patterns in this direction, it would be useful to determine the hardware changes, shell improvements, behavior, knowledge, and economic parameters that correspond to low use circumstances. Because low use patterns almost certainly correspond to different sets of conditions, or combinations of the above, this approach could illustrate a multiplicity of pathways attractive or desirable to different demographic groups. Lutzenhiser's recent descriptive work on the patterning of home energy consumption has already identified demographic variables that correspond to higher and lower energy consumption (2006).

Historical lessons

Another possibility would be to compare the present moment, when significant absolute reductions in energy consumption are deemed necessary, with, for instance, 1978 when US households managed to reduce their total (not just electrical) energy consumption by 13% over the following three years—from 205 to 178 M BTU/household (Hirst, 1984). What factors contributed to that reversal of energy consumption growth? What made that moment so unusual? Are there lessons in that experience that could be applied to the present situation?

Since 1960, California has only once experienced two consecutive years during which total statewide electricity consumption dropped (1982/83). Planning for forty-five such declines in a row is certainly ambitious. However it is worth keeping in mind that the goal of achieving such sustained reductions has not heretofore been incorporated into state planning efforts. Nevertheless net annual reductions in statewide electricity consumption have occurred in California in nine of the past forty-five years: (1974, '80, '82, '83, '91, '93, '95, '99, & 2001). Yet these reductions always corresponded to economic downturns, energy price shocks, or supply uncertainty. Policies put in place at these times generally focused on "weathering the storm" rather than working toward long term negative growth in electricity consumption. While the impossibility (and even undesirability) of perpetual growth in energy consumption was recognized in the decade following the first oil price hikes of 1973, over the past twenty years the policy emphasis shifted to ameliorating the short term inconvenience associated with occasionally higher energy prices.

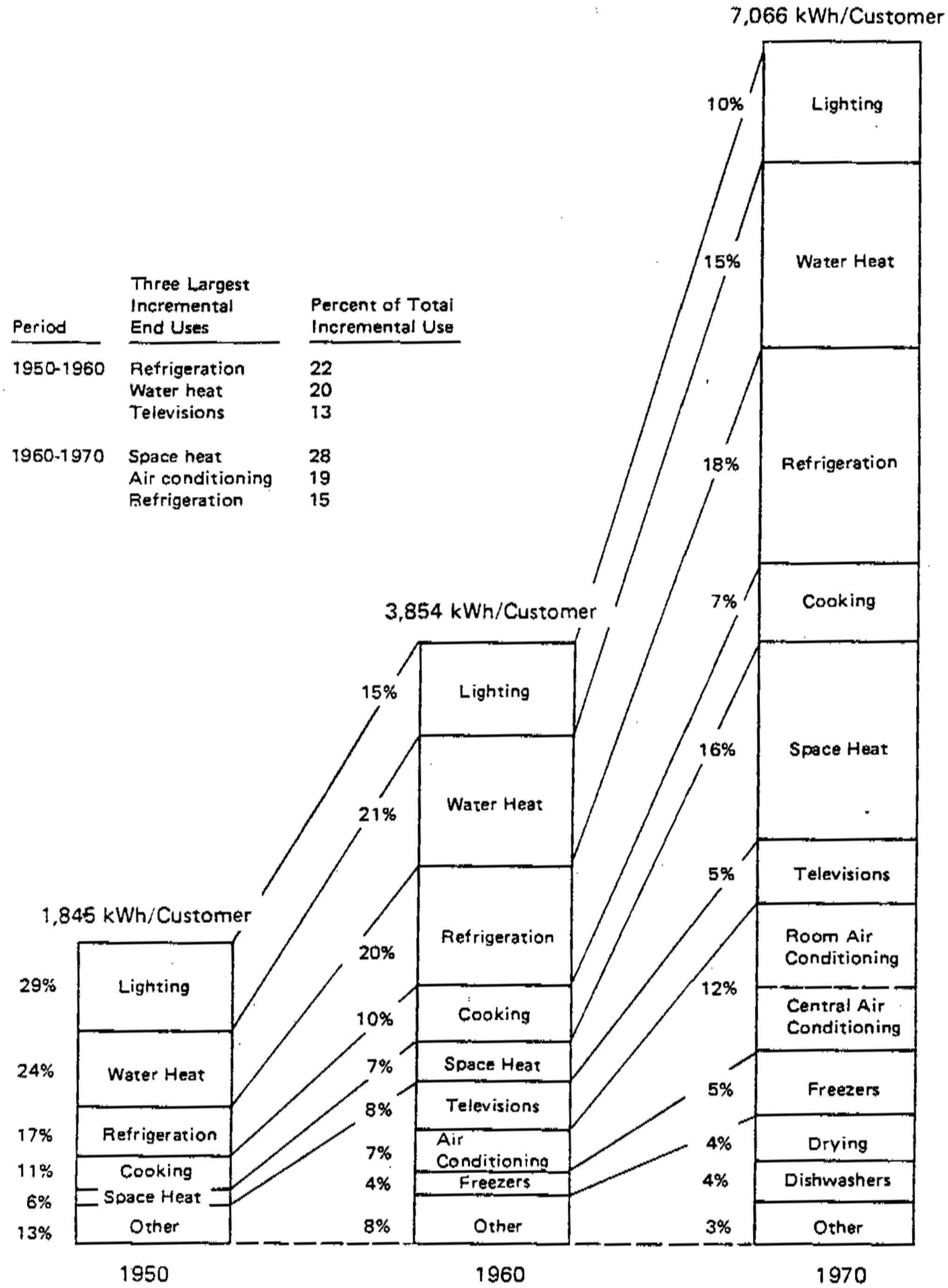

Figure 2: Residential electric use patterns 1950, 1960, and 1970. Source: Tansil & Moyers, 1974

Policymakers who have experience with the pursuit of energy efficiency now concede that even with very high levels of funding the application of energy efficiency on a grand scale has failed to rein in per capita growth in energy, much less total statewide energy consumption (Moezzi & Diamond, 2004; Rosenfeld, 2006). On the other hand, a focused and thorough energy efficiency program such as the HRCP, special circumstances of extreme price/supply uncertainty (California in 2001 as well as nationwide between 1978 and’81), as well as occasional innovative incentives and programs, have yielded large declines in energy consumption. The challenge must be to borrow from these experiences the salient strategies and approaches and apply them toward this (new) goal of sustained absolute reduction in statewide energy consumption.

Furthermore, the average annual increases of almost 8% in total electricity consumption in the state and the nation through the 1960s did not happen without encouragement. These increases were deliberately pursued as policy (Vennard, 1961; see also Figure 2). Undoing this Cold War legacy is both necessary and possible, even as the unprecedented scale of the problem, and consequent uncertainties about how the task is to be done present special difficulties. Although much of this growing energy use had been built into our infrastructure, buildings, appliances, cultural norms, and habits, and we have had several decades over which to learn the patterns through which we now consume electricity and other forms of fossil fuels, significant change in the opposite direction, including rebuilding the social and physical energy infrastructures, is possible if policymakers take up the challenge.

Conclusion: A pluralist approach

A top down, centralized statewide effort is unlikely to lead to success in reducing California's energy consumption. There is a need to conceptualize the problem as benefiting from the broadest possible public support. This leads to the question of how best to motivate or inspire the public to recognize the problem as something they not only want to address, but can do something about. Encouragement, incentives, guidance from local, trusted sources, success stories, better information, and possibly changes to the design of electricity rates are but a few of the possible strategies in pursuit of this goal. Energy authorities can help the State advance toward these goals only if people from all sectors and groups participate, and even occasionally lead. The best strategies and ways of thinking about the problem and its possible solutions may in fact not come from experts at all.

An open public conversation is needed about what sorts of things, what social arrangements, what systems of provisioning, are—and are not—compatible with the reductions in energy consumption now mandated. Though perhaps obvious, it is nevertheless worth pointing out that the average Californian once lived well using far less fossil fuel than the average today. And some Californians still do. Statewide, the average household supplied with electricity by an IOU consumed roughly 6,700 kWh/yr in 2005. Sixteen percent of this number is 1,100kWh/yr, which is roughly equal to the Executive Order S-3-05 target for average residential electricity consumption in 2050. This corresponds to perhaps the 5th[12] percentile of California residential electricity consumers. In other words, fully 5 percent of households already consumed less electricity in 2005 than the AB32 target requires of the *average* household by 2050. Yet we know nothing about the demographic, socioeconomic, or technical features characterizing the lives of the people living in these roughly 650,000 households.

Framing the problem as energy efficiency advocates have done is not helpful in pursuing this sort of goal. Expanding the frame to include attention to social forces shaping energy consumption, as well as methods with which to influence or overcome these, and incorporating

[12] These percentile figures and household number are the author's estimates. The fact that the CEC cannot supply a number suggests some of the distance we must yet go before understanding the problem fully.

metrics with which to track total consumption will, however, improve the chances of success. By paying attention to people as energy consumers, by adjusting energy prices and rate schedules, by pursuing creative strategies, and by setting and communicating ambitious goals, it is possible to achieve the necessary reductions.

Many roads lead in this direction. Because the superhighway that energy efficiency built has attracted so much traffic over the past twenty years, the money now spent on adding new lanes is insufficient to keep cars moving. Many who now habitually use this highway have forgotten the varied landscapes through which they once traveled, or the pleasures of not traveling. Encouraging rediscovery of the myriad ways to use less energy (both past and future) should be a point of departure as we reorganize our state to comply with AB32.

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